

An Abstract of a Letter of Mr. Anthony Leewenhoek Fellow of the R. Society; concerning the parts of the Brain of severall Animals; the Chalk Stones of the Gout; the Leprosy; and the Scales of Eeles.

HAVING lately been employed about the Eyes of Turkey Cocks, I proceeded to examine the Brain; and tho' in my Letter of the 14th. of May 1677, I have already treated of that subject, I shall take no notice thereof, but lay down my Observations I hope more distinctly and substantially then before.

I first took in hand the *Cortical* parts of the brain of a Turkey Cock, these parts (a great number of small blood Vessels and small Globules excepted,) consist of a very clear Crystalline Oily matter, which for its transparency ought rather to be named *Vitreous* then *Cortical*. When I separated a little of this matter from the rest, there flowed from the place (tho' it spread less then $\frac{1}{10}$ th of a hair,) a little thin moisture, containing in it some extream small Globules, less then $\frac{1}{3}$ th part of one of those which make the rednes in the blood. It is to be noted that this fluid matter, was cheifly in the brain of such Turkeys, as had been dead for some time. It is also not improbable, that a part of this moisture might flow out of some of the small Vessels, or that some of the very minute Vessels might have been turned into a watery substance.

Besides the above mentioned small Globules; there were also some about the bigness of $\frac{1}{2}$ th of a Globule of our blood. These two sorts I conceived might have come from small Vessels which by chance I had broken, being made out of the grosser parts of the fluid, at the time that the humours grow cold and stagnate.

Together with the above mentioned Globules, there

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were some transparent irregular ones, as big or bigger than a Globule of our blood, which lay among the branches of the blood Vessels, in a space no bigger than a course sand. Many of these blood Vessels were so small, that if a flat oval particle of blood (which causes the redness therein,) being supposed to be perfectly Globular, were divided into 500 parts, yet could not one of those parts pass thro' their Cavity's, without being more divided and fitted to enter them. For if the wideness of the Cavity, be as 1. the Diameter of the Globule is as 8. and consequently the proportion as. 1. to 512.

Tho' these blood Vessels were so small, as is before said, they had notwithstanding such a degree of colour, that I could discern the matter in them, to be that which maketh the blood red. And I was further confirmed in my Judgment, by observing that other blood Vessels, which were some what thicker, appeared proportionably higher coloured, and more inclining to red: and that the redness appeared more plain, when 3 or 4 Vessels lay immediately one over the other, without any other matter intervening.

The cause of the brownish colour of the *Cortical* parts, I take to be the great number of Veins and Arteries, which run thro' the transparent substance, whereof these parts chiefly consist. To which may be added that there were severall particles mixt about as big as $\frac{1}{8}$ of a blood Globule, which were not transparent. We may perceive that the *Cortical* parts in many places enter deep into the *Medullary*, but if we diligently search into them, we shall find them as full of blood Vessels as the outside.

Besides the aforementioned very thin blood Vessels, there are other Vessels in the brain, so thin, that I conceive a round body (as aforesaid,) altho' divided into above a 1000 parts, could not pass through them.

'Tis to be noted that in these Observations, are mentioned only such blood Vessels, which are as thick or thicker than a hair of my head. But

But to come to the *Medullary* parts of the brain, there in were contained irregular Globules of different sizes, some of which were of the bigness of a Globule of our blood, and some larger, seeming to consist of a thin transparent Oyl-like substance; these are here in such numbers (chiefly where the *Medulla spinalis* beginneth,) that they seem to compose the greatest part of the brain. This great number of transparent Globules, causes a white colour (for all transparent bodies, which are not so united together, that the Ray of light can in a streight line pass through them, and so make them as it were one body, must produce to our sight a white colour, as I have formerly often said,) these irregular Globules, were yet so fast joyned the one to the other, that (when I had layd them very thin, or single before me, and endeavoured to separate them,) some would be drawn out to twice their naturall length, and then seemed to me, as if they were kept together by netlike threds. This made me think, that the smallest branches of the blood Vessels might incompass these Globules, as we find the small Horizontall Vessels, in some kinds of Wood, give way to the great perpendicular Vessels, and wind half about them. And I was confirmed herein, when I perceived, many of the foresaid Vessels, appeared clear in the middle; and brownish on both sides; but more brown, when I had torn the Globules asunder, and lay'd the thin thred-like parts by themselves.

In fine the *Medullary* parts of the brain, appeared often like a fishers net, between each of whose Meshes, was placed a very plyable ball-like substance; which changed its figure into round or Oval according as the said Meshes were stretched one way or other. Moreover the said *Medullary* parts consisted of a very great multitude of very small Globules, and some clear thin matter, which last, I also Judged, to have flowed out of the Vessels, that were broken, as also, that some of the Vessels, might have been turned into a Watery substance. I

I observed also the brains of a sheep, and perceived in the *Cortical* parts, a very great multitude of extream thin blood Vessells, containing some of the substance, which maketh the redness of the blood; whereby the *Cortical* parts become of a brownish colour.

While I viewed the incomprehensible number, of these small Vessells; It was very delightfull to me, to contemplate how every one of them, spread it self into severall branches.

There were also a great number of Globules not so transparent as others that were near them, and that were in size as $\frac{1}{2}$ of a Globule, which maketh the redness in the blood: these I Judged to have been extravasated, by the tearing of the Vessels asunder, and to have been six of them compounded together, when the Vessells were wide enough to carry them; but when the Cavities were so small, that they could not pass thro' them, they then broke into lesser parts, and lost their colour.

For the better representing the inconceivable thinness of the blood Vessells, I made the following Calculations. *viz.* 100 red Globules lying side by side, do not equall the Axe of a Sand; let then a Million of them be equall to its solid content. There are blood Vessells in the brain, which I judge $\frac{1}{64}$ part of a blood Globule would be too big to pass thro'; so that the Diameter of the Vessell, is to that of the Globule, as 1. to 4, and if a course Sand be divided into 64 Millions of parts, 1 of the parts (if it be stiff and unplyable,) will not pass thro' one of the smallest Vessells of the brain.

To proceed, the *Cortical* part of the brain, was constituted of such a cleer and Glass-like substance, as I have above mentioned; only with this difference, that it had white streaks or lines, thinner then a hair of my head, which to the naked Eye were invisible. These I judged to be occasioned, by a more then ordinary number, of very transparent great Globules layd together. I have also

also perceived, brown streaks running thro' the *Medullary* part of the brain, which were only caused, as I conceive, for that there were but few, or none of those transparent Globules, there placed.

I examined some of the parts, which lay near the beginning of the *Medulla Spinalis*; and I sometimes thought, I had found out a thing that I was doubtfull of, in the brain of a Turkey: *viz.* That the great transparent Oyl-like Globules, were, as it were surrounded, with an innumerable quantity of extreme thin, and net-like Vessels or streaks, mixed with some thicker Vessels, which lay in a line, and excelled in transparency, causing thereby, where they lay in numbers together, the brain to appear very white: these were in thickness about $\frac{1}{25}$ th part of a hair or something less. The other substances were little differing from what I have before mentioned in the brain of a Turkey.

Afterwards, I carefully examined the brain of an Ox, and satisfied my self, that the *Vitreous*, and very transparent matter, which makes up most of the *Cortical* part, consisted of nothing but extreme thin streaks or Vessels, which were neerly joyned together: but at another time, I could not to content, assure my self concerning the same. As to the remaining substance of the *Cortical* parts, I could discern no difference, from the brain of other Animals; but that there was not such a Quantity of fluid matter, as in Animals which had been longer dead. I found also the *Medullary* substance of the brain, to be such as I have before mentioned in a sheep: for it had very white streaks, in the parts from whence the *Medulla Spinalis* taketh its rise: this extream whiteness, was from several very transparent Vessels, which lay next one the other, and seemed to me, only made to carry the matter, by which, the *Medulla Spinalis* and Nerves, are partly nourished and maintained. The greatest of these last Ducts, (by guess,) was about $\frac{1}{100}$ part of the thickness

of a hair of my Beard ; but at other times, I have discerned them thicker, and according to all likelyhood, I here met with a place, where these transparent Vessels were thinnest. In all these my Observations, I pass by many blood Vessels, which are visible to the naked Eye: for they are to appearance, like whole Rivers; whereas the other smaller Vessels, of which I have before spoken, seem, but like small Ditches or Channels.

I have also examined, the *Vitreous* or transparent parts of the brain of several Sparrows, immediately after their being killed; and have therein, not only clearly discern'd, a great number of small blood Vessels, as in a Turkey; but as plainly, as in an Ox, or sheep. Also the other parts, of the brains of a Sparrow, were very near of the same bigness, with those of an Ox: there being no other difference (the great blood Vessels excepted,) but, that these consisted of a greater number of the same parts. There were also, in the *Cortical* parts, an incredible number of extream small Vessels, lying so close to one another, that by reason of their transparency, they look't like Glass. The smallness of these Vessels, I have so often measured, that I have no scruple remaining: nor will any one else doubt, who considers, what the Organs must be in Insects, or what proofs thereof, we have within our selves. For, as I lately anotomized the Eye of a Man, I compared a streak or Vessel, I found in the *Choroides*, with the Axe of a course sand, that was $\frac{1}{30}$ th of an Inch, making upon my Scale 330 Microscopical parts, now 8 of these streaks, lying by the side of one another, made but $\frac{1}{330}$ of the Axe of the sand, so that the foresaid Axe, is 2640 times broader then the streak. This number 2640, multiplyed Cubically, to finde out the solid content, it will make out, above 18 thousand millions: so that a cours Sand, as before is said, ought to be divided, into so many thousand million parts, before it could pass so thin a Vessel.

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The *Medullary* parts here, consist chiefly of very small streaks or Vessels, together with many small blood Vessels; as in the rest of the brain: otherwise they differed little, from the same parts of an Ox, Sheep, or Turkey; as I have before described them, only, the transparent Oyl-like Globules, were not so large, but, when I observed the brain of a Sparrow, which had been 24 hours dead, I saw the transparent Oyl-like Globules, as great, as those in the brain of an Ox, or other Animals. From this last, and other Observations, I have been considering, whether this great number of clear transparent Globules, might not, when the Animal was alive, have been designed to feed the *Medulla Spinalis* and Nerves: tho' now that Animal is dead, and the humours cease to flow; the particles that toucht one another, congeal into figures of different sizes: For the blood that is carried by the Artery's, into the *Cortical* part of the brain, does not return thence, by the Veins, but is prepared in the *Capillary* Vessels, till it be fit for the nourishment of the *Medullary* parts.

This may seem strange to some, who might object that because of the redness of the blood, the brain ought to be reddish of colour; but that followeth not; for the green Globules, of greenish flegm or snot, are truly blood Globules, which have changed their colour, being still of the same size with them, and consisting each of 6 distinct Globules, as they doe: and I conclude that as these are changed, from red into green, that also, as likely the red may loose their colour, and become white; especially when they are divided into very small parts as they must be, before they pass into the *Capillary* Vessels.

I have lately examined the Chrystalline humour of the Eye of a Man, that I might know, whether the small threds of the Scales, wind about in the same manner, as I have formerly described them, in the Eyes of beasts: but I could not discern the true constitution thereof,

notwithstanding I have twice, and at two distinct times, endeavoured it. This I observe, that the Chrystalline humor was not fine, and cleer, but yellowish, whereby it differed from the Eyes, which I had formerly seen of other Animals.

I have read the Book of Dr. W^m. *Ten Rhine*, out of which I cannot but note, that the said Dr. agrees with my Observations concerning *Moxa*, written the 14th of May 1677. namely that *Moxa* is no artificial preparation of the Choicest Herbs, made by the Chineses and Japoniers, as H. *Bushof* affirms, in his Book of *Moxa*, pag 52. ' Saying, none of all the Druggists of Europe, have ' any knowledg of the manner of preparing this *Moxa*; ' and by those of *China*, this Art is of such esteem, that ' they will not for any money, discover it to a Stranger. But my opinion is, that *Moxa* is only a production of a fruit, like the downy substance about the Peach, the Quince, and such like: and Dr. *Ten Rhine* holds, that it is a Wooll, of some leaf. I related also, in my fore-mentioned letter, that I had made tryall of the burning of the *Moxa*, on my hand; what difference there was between that and Cotton, what may be the reasons why the Chirurgeons esteem Cotton fiery and churlish, why it hurts a wound, when a band is made therewith, *viz.* because the hairs are flat, and have sharp edges or sides.

I have tryed many other Woolly substances, which grow on some leaves and fruits, in what manner they burn, and chiefly the Woolly substance which the Poplar Tree sheddeth; which Wooll, I had a conceit, when I had viewed it with my naked Eye, that it would burn quick: I had also the same Opinion, of the Woolly substance shed by the Willow Tree, in the beginning of June; which last, in the tryall excelled that of the Poplar Tree. But I have yet met with no Woolly substance, growing with us, which burneth so well as Cotton; and those, who with

us, undertake to cure the Gout, or any other disease, and have no *Moxa*, I would recommend to them Cotton.

I have also tryed the tinder of burnt linnen, but this burneth more fierce, and deep at once, then would be done at 10 times, with *Moxa* or Cotton.

A relation of mine, much troubled with the Gout, has his heel spoyl't with the great quantity of Chalk, that breaks out of it; this matter I examined in my Method, and separated the same in 3 parts, the first was the dryest, and whitest, made of small irregular parts, as if some small sands lay together; these thro' the Microscope appeared very dark bodies, and each of them consisted of a great number of long transparent figures; which I can liken to nothing better, then to cut Horse-hair, some thing sharp at both ends. These figures I judged so thin, that more then a 1000 of them lying close together, would not make out, the thickness of a hair of our head: I have represented some of them, that their proportion in thickness, to their length, might be comprehended, as Fig. 4. *A*. I have also found that these parts lay in very good order, one by the other, as in Fig. 5. *B*. and sometimes 2, 3, or 4. and more in length. I have often separated these small sand-like parts, one from the other, and again divided each of those parts, and then, I have not only seen, the figures which constitute the white matter, as Fig. *B*. but for the most part, in a confused order, as Fig. 6. *C*. I have also seen some of these figures so short, that some of them were in length but $\frac{1}{2}$ of Fig. *A*. and some but $\frac{1}{3}$ yea $\frac{1}{4}$ thereof, as here Fig. 7. *D*. but I conceived this was not their true length, but, that in the handling, they had broken. Among these figures, lay some irregular parts, which were again constituted of Particles, which I judged, had been Globules of blood, and had here in pressing, bin broken or bruted; As also many roundish parts, which I judged, had been $\frac{1}{2}$

of a blood Globule : also some small roundish particles, which I judged so small, that 36 of them, would constitute but one Globule of blood.

The 2d sort of this Chalky matter, not so white as the former; contained the forementioned irregular parts, of long figures, in a very tough clear matter, mixed with blood Globules, and very many of the forenamed small roundish parts.

The 3d sort, was to the naked Eye, somewhat reddish; caused by the many blood Globules, mixed, throughout the slimy matter in the Chalk : It was also constituted of the beforementioned roundish parts.

Altho' with us the Hospitals (of the Lepers,) are in many places ruined, or converted to other uses; and some learned Persons, maintain, there is here no such Incurable Leprosy; there are notwithstanding, at Harlem, Searchers appointed, to visit such Persons, as repair to them, pretending to that disease; who have power to grant men a sealed Certificate, and a Clapper, whereby they are authorized, to beg their food, for 4 successive years; after which time, they must be again reviewed.

I inquired of one of these licensed Men, wherein his disease consisted, and he shewed me his head, which was all covered with a skin, that scaled off, and red dry scabs: these scabs I guess to be caused by his scratching, or rubbing the part that itched, till the blood came, which blood afterward's dried upon the place. This Person, as he said, had his body whole and sound.

Another of about 36 years of Age, had all his head and face sound, and his head covered with black thick hair; but he said, his whole body (part whereof I saw,) was beset with great and small, white and red splotches, and also red scabs: the white splotches, were places from whence the scabs, of their own accord scaled off; the red scabs, were caused as before, by the hard scratching

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ing of the place, which caused the blood to issue out, and which dried thereon; as the infected person also acknowledged. This person had been undertaken to be cured by 3, severall men; the first, pretended to do it by Salves, but without effect: The second, by blood letting; which he reiterated so often, that the Patient was much enfeebled thereby, but had no benefit; the third, who pretended great skill, purged him so often, that he became much weakned thereby; and was rather worse: so that in the end, he was fain to repair to Harlem, for a Licence to beg. I caused this man to scratch gently some of the scales off from his leg, which I preserved in a paper, and afterwards observing them, I found that in many places, they were beset with small parts of dried blood and matter. A 3d person, whom I met, was a Youth about 12 years of Age, his head was covered with such foul fores, that I could not stay to view it, without loathing.

A 4th person I met, was a Woman, about 30 years of Age, who was likewise permitted to beg; she said, her disease consisted in the skins scaling from her head, which extreemly itched, and when scratched, did very much pain her, and also bled, and caused those red scabs. She offer'd to uncover her head, but I was satisfied without it; the more for being from home, and lodging at a Friends house.

Of the Scales of Eels.

Among the Fishes, which are generated in our Rivers, and waters, I know but of two sorts, that are said to have no Scales; the one sort is the Eele and *Paelink*, in some places not distinguished, but with us they are distinguished: the *Paling* being flatter and pleasinger in taste, and therefore sold dearer: the 2d sort, is the *Eelpout*; this last sort are short, and thick, and scarce to be met with, which

which two sorts of Fish, the Jewes will not eat, as forbidden by the Law of Moses Deutr. 10, 14, &c.

I examined the skins of these Fishes, after I had cleared them of their slime; and found them covered with Scales, as much as other River Fish: for the Scales, altho' very thin, and small, lay orderly, and close fastned one over the other. Besides these Fishes are also provided with Fins, like other Fish; for they have on each side of the head, a perfect Fin; the whole hinder part, or Taile, is as well above as under, furnished with a continued Fin. And for as much as this may seem strange to some, and chiefly to the Jewes; who for want of a more neer search, into the constitution of this Fish, have been diverted from so relishing a food: I caused one of those Scales, which I had taken from under the Belly, where they are the least, to be drawn out, as viewed by a Microscope: but while the Artift was imployed in the doing thereof, he said, he could as soon cut it in a Plate, as draw it, and I therefore caused him so to doe: of which you have here the Print Fig. 8. *ABCD*. is the Scale taken from the Belly of a great Eele, the Circumference of whose head, was neer 7 Inches; but the Scales on the back, and sides are larger: the greatest part of this Scale *ADC*. was covered by two other Scales: the part *B*, lay extended towards the Tail: the rest lay aftet the same manner. These Scales are for the most part, constituted of round Balls, and some oblong, in which Balls, in many places, appear figures, like a spiderswebb; which for the extream finess and smallness, could not be imitated: the Globules constituting each Scale, are very transparent, but some more then others: and in each Globule, appeared a darkish spot; those less transparent Globules, lay one by the other, and made different Circular lines in the Scales: altho' all the Scales, are not just of the same shape; I have yet observed, in many of them, as I judged, the same number of Circular lines. From
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whence I conclude, that every year, the Scale encreased one Circular line; and by consequence, the number of these Circular lines, being seven; the Fish must have been seven years old. These Circular lines are here denoted Fig. 8. by *EFGHIKL*. Fig. 9. is the same Scale in size, as it appears to our naked Eye.

I have also examined, the slime lodged on these Scales, but I can say little thereof, till I have made further Observations. &c.

Delft July 25th, 1684.

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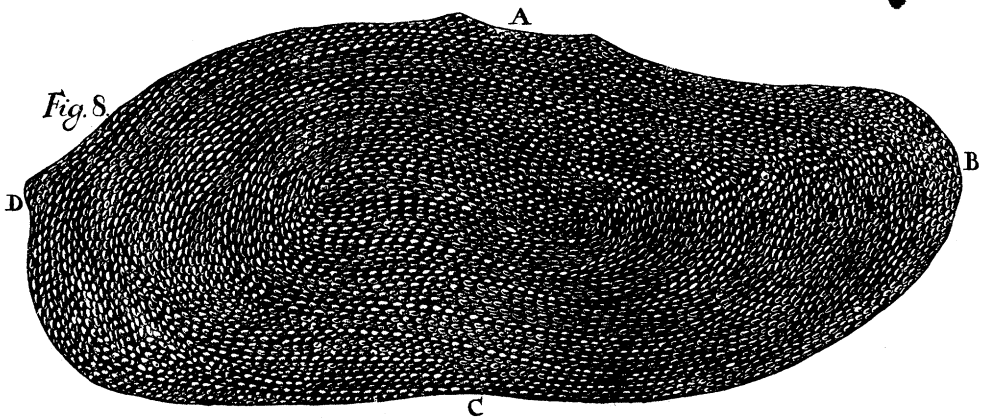
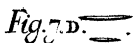
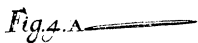
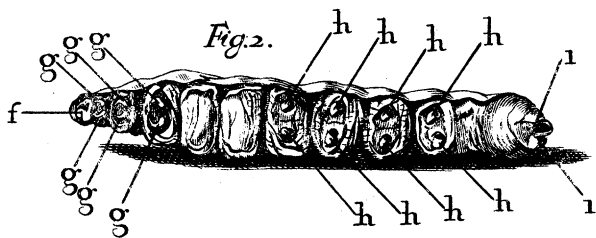
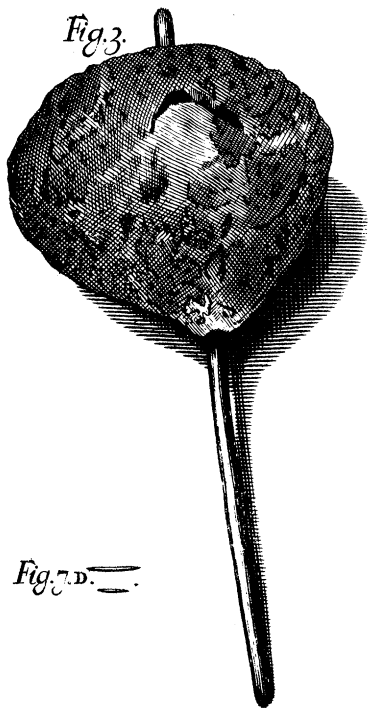
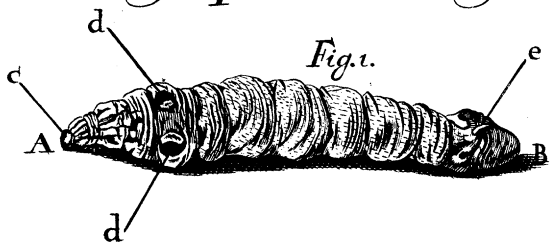


Fig. 9.

M. Burghers sculp.